Memo for 06/36-07/02/2003 experiment on X17-B1

I. THERMAL EXPANSION

We measured PZN thermal expansion, using the (111) reflection. Radial scans along (111) give lattice parameter vs T (see Fig. 1). a is virtually a constant through the whole temperature range (15 K to 750 K). Measurements on (200) peaks also confirmed this.

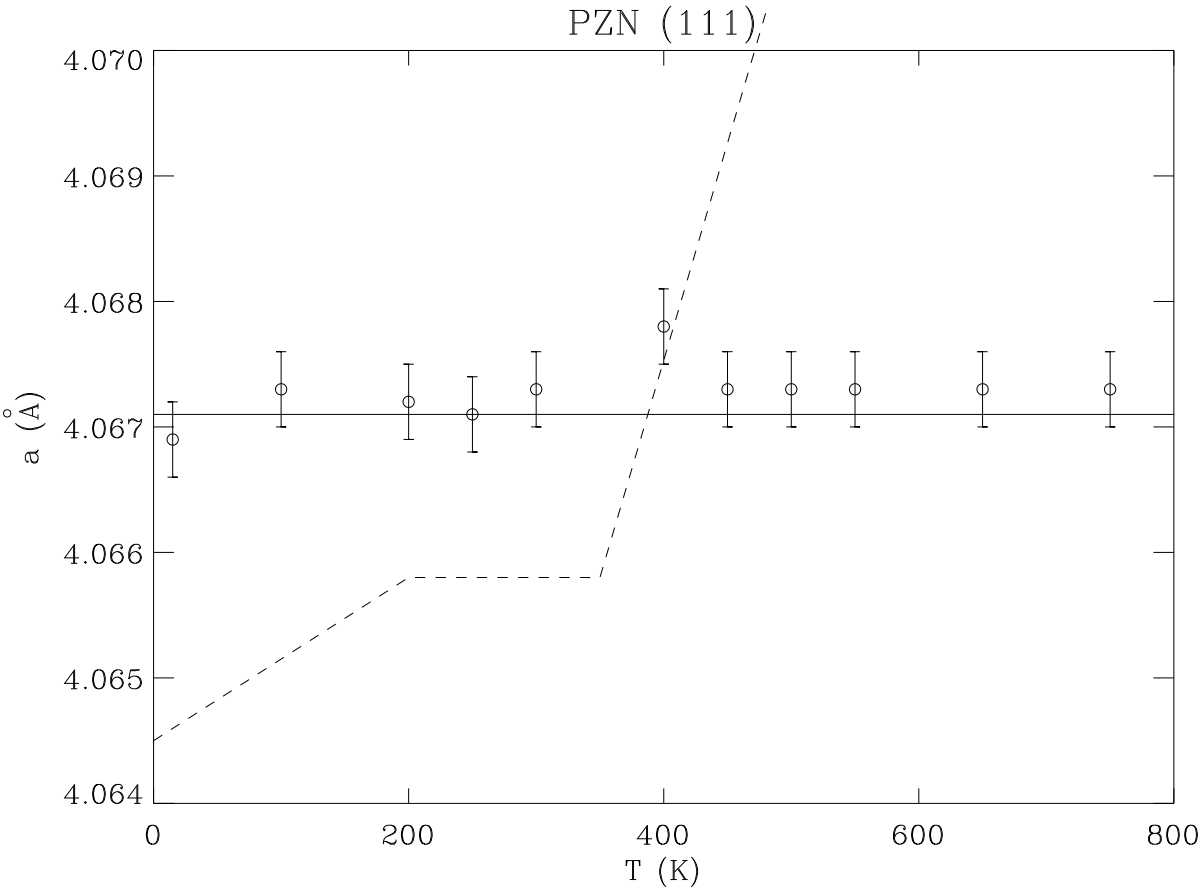

FIG. 1: Lattice parameters obtained in X17-B1 diffraction measurement on the PZN single crystal using the (111) reflection. The dashed line show measurements of Dkhil *et al.* on pure PMN. (G-6)

II. TETRAGONAL DISTORTION IN PHASE X?

We measured three $\{200\}$ peaks at 15 K, where PZN is in the X phase. The lattice parameters of (200), (020), and (002) are,

$a = 4.0660$Å (200),

$b = 4.0669$Å (020),

$c = 4.0668$Å (002).

The variation is 0.02%, ten times smaller than previous measurements (10/31-10/4/2002, on X17-B1), i.e., no detectable tetragonal distortion in phase X.

III. PHASE TRANSITION AND LINE BROADENING

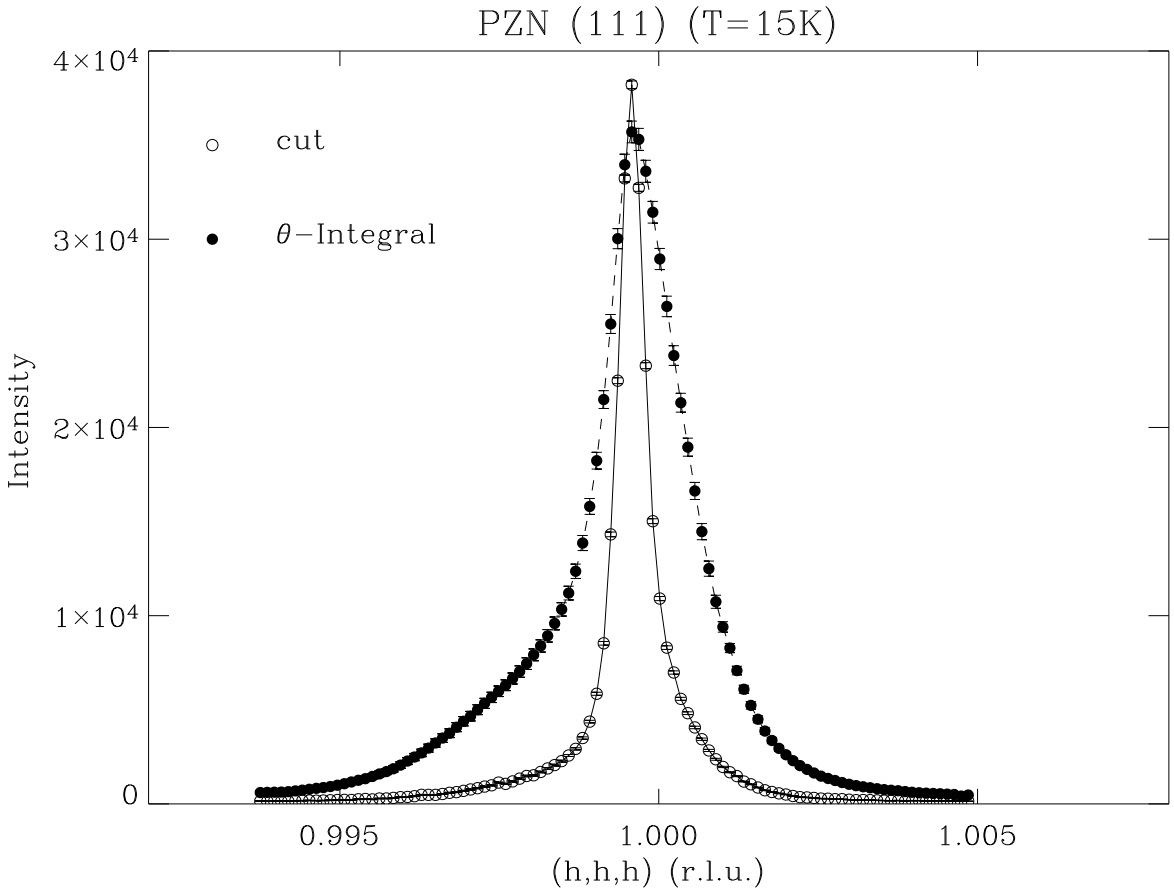

FIG. 2: Comparison of a cut through the (111) mesh along q, and the line profile with integrating θ (i.e., bad transverse resolution). (G-7)

We measured the width of different Bragg peaks (111) and (200) through $T_C \sim 410$ K. The width of (111) peak remains sharp in the longitudinal direction both above and below T_C. The transverse width (mosaic) of (111) peak changes very little through T_C but the line shape changes from Gaussian shape to Lorentzian shape (more intensity to the tails). The Bragg intensity increases with temperature, no anomaly at T_C has occurred. We did a mesh scan around (111) peak at 15 K. A cut along the radial direction gives a sharp peak (FWHM 0.0005 in (h,h,h)), the same as the sharp peak we get by doing radial scans directly. But if we integrate the data along θ, i.e., if we have a bad transverse resolution, as in the case of our neutron measurements, the profile has a much broader peak (Fig. 2). The FWHM of the peak with integrating θ is about 0.0015 r.l.u. in (h,h,h) direction. I think this explains why neutrons see broader peak below Tc - mainly due to the bad transverse resolution.

The (002) Bragg peak is, however, more sensitive to the change of temperature. The longitudinal width does not change much with T. By monitoring the mosaic (transverse width) of (002) peak, we see a change occurs at T_C (Fig. 3). The line shape of the profile also changes from Gaussian (above T_C) to Lorentzian (below T_C) (see Fig. 4).

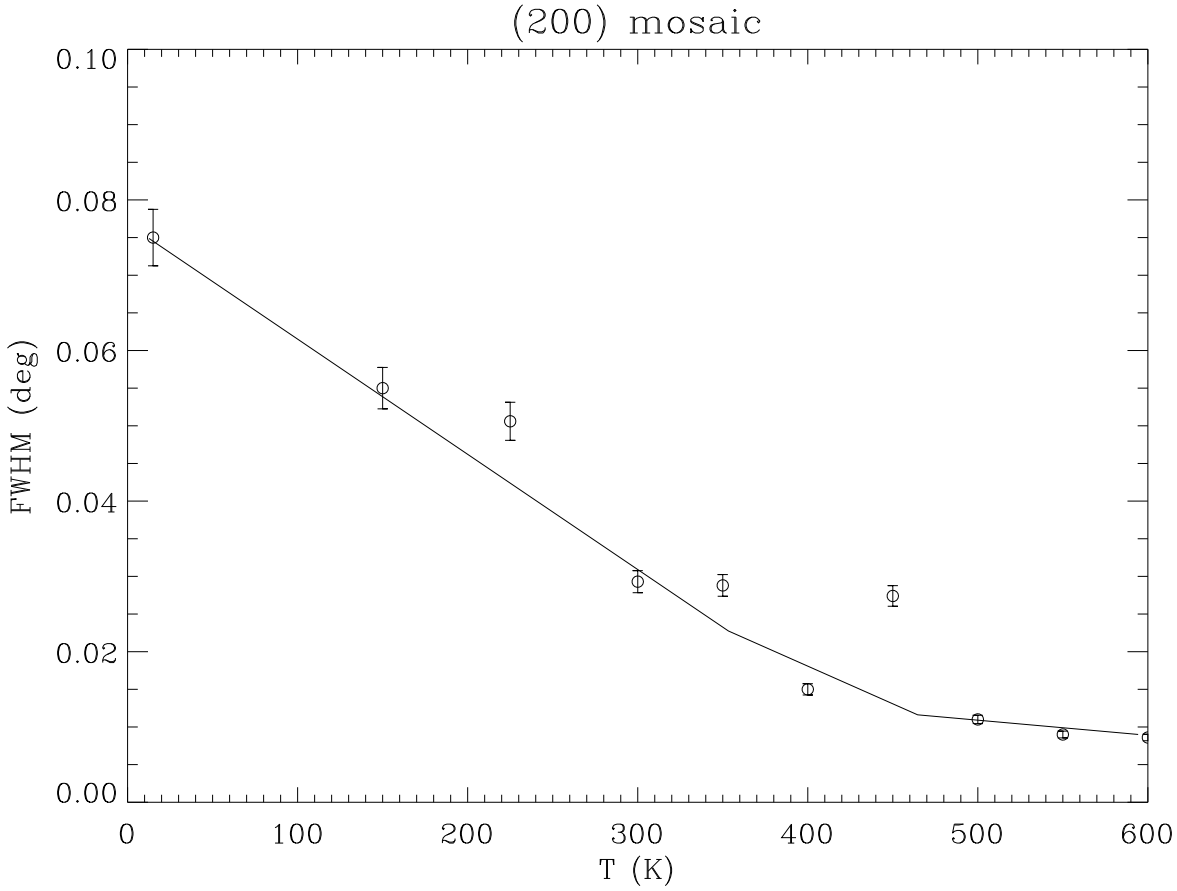

FIG. 3: Transverse width (mosaic) of the (002) peak vs T. (G-8)

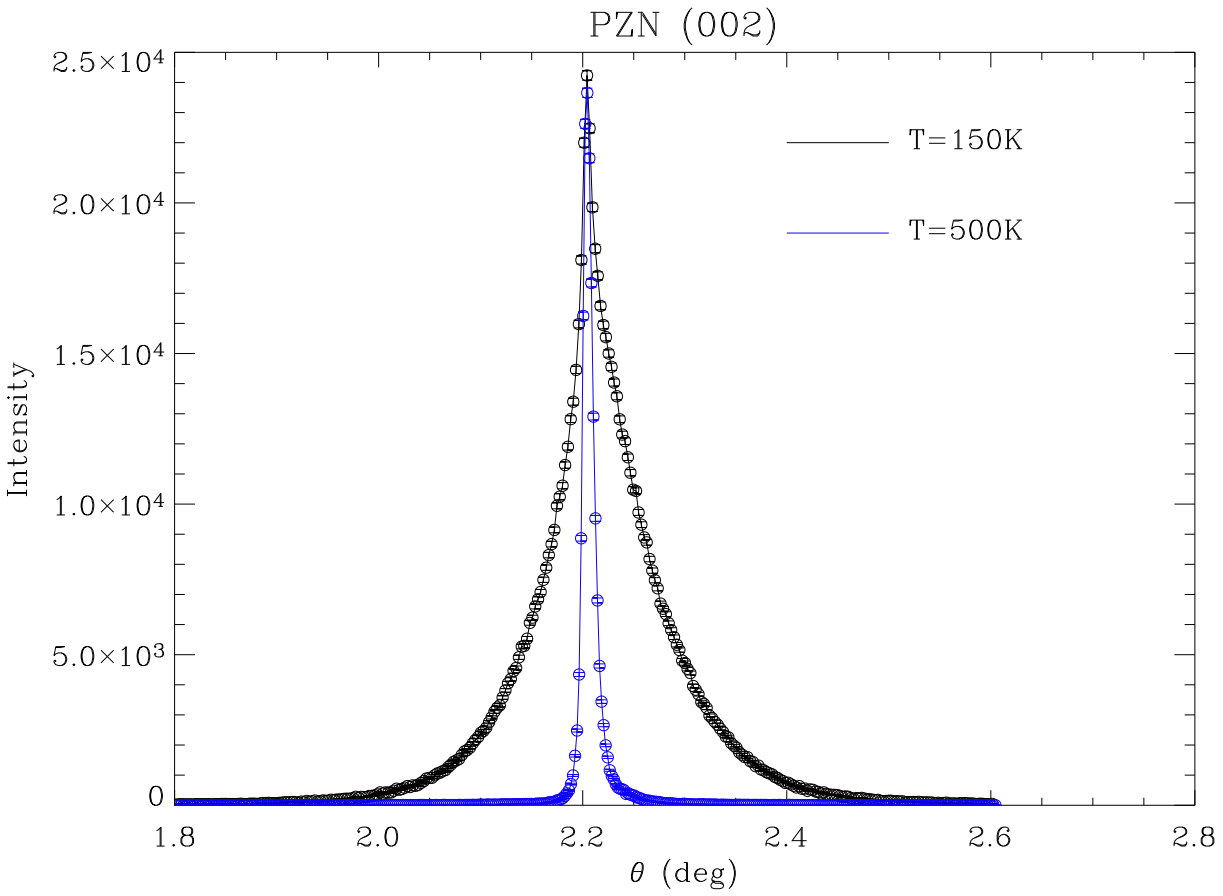

FIG. 4: (020) transverse scans (θ scans) above and below T_C. (G-9)